

## CLAIMS

WHAT IS CLAIMED IS:

- 1        1.    A method of fabricating a semiconductor device  
2               comprising the steps of:  
3        /       a)       forming a non selective N type buried layer  
4               comprising a first majority dopant having a  
5               first coefficient of diffusion; and  
6               b)       forming a selective P type buried layer  
7               comprising a second majority dopant having a  
8               coefficient of diffusion greater than said  
9               first coefficient of diffusion.
  
- 1        2.    The method set forth in claim 1 wherein the step  
2               of forming said non selective N type buried layer  
3        /       is performed before the step of forming said  
4               selective P type buried layer.
  
- 1        3.    The method set forth in claim 1 wherein the step  
2               of forming said selective P type buried layer is  
3        3c       performed before the step of forming said non  
4               selective N type buried layer.
  
- 1        4.    The method set forth in claim 1 wherein the step  
2               of forming said selective P type buried layer  
3               includes the step of controlling the amount of  
4               said second majority dopant relative to the amount  
5        \       of said first majority dopant such that said  
6               selective P type buried layer over compensates  
7               said non selective N type buried layer completely  
8               throughout said non selective N type buried layer

9 in a region where said selective P type buried  
10 layer is formed.

1 5. The method set forth in claim 1 wherein the step  
2 of forming said selective P type buried layer  
3 includes the step of controlling the amount of  
4 said second majority dopant relative to the amount  
5 of said first majority dopant such that said  
6 selective P type buried layer does not completely  
7 over compensate said N type buried layer  
8 throughout said non selective N type buried layer  
9 in a region where said selective P type buried  
10 layer is formed.

1 6. The method set forth in claim 1 wherein the step  
2 of forming said non selective N type buried layer  
3 includes the step of selecting said first majority  
4 dopant from one of arsenic or antimony and the  
5 step of forming said selective P type buried layer  
6 includes the step of selecting boron for said  
7 second majority dopant.

1 7. The method set forth in claim 1 wherein the step  
2 of forming said selective P type buried layer  
3 includes the step of controlling the amount of  
4 said second majority dopant relative to the amount  
5 of said first majority dopant such that said  
6 selective P type buried layer has a maximum dopant  
7 concentration greater than the maximum dopant  
8 concentration of said non selective N type buried  
9 layer.

1 8. The method set forth in claim 1 further including  
2 the steps of:  
3 a) forming an N type layer on said non  
4 selective N type buried layer; and  
5 b) forming a P well extending from said  
6 selective P type buried layer through said N  
7 type layer.

1 9CB 9. The method set forth in claim 8 in which ~~the~~  
2 2/22/02 dopants from the N type and P type buried layers  
3 | diffuse into the N type layer.

1 10. The method set forth in claim 9 in which the  
2 dopants of the P type buried layer extend further  
3 into the N type layer than do the dopants of the N  
4 type buried layer.

1 11. The method set forth in claim 8 wherein the step  
2 of forming said P well includes the step of  
3 controlling the amount of a majority dopant used  
4 in forming said P well relative to the amount of  
5 said first majority dopant such that the maximum  
6 majority dopant concentration of said non  
7 selective N type buried layer is greater than the  
8 maximum majority dopant concentration of said P  
9 well.

1 12. The method set forth in claim 1 wherein the step  
2 of forming said selective P type buried layer

3 includes the steps of implanting and diffusing  
4 said second majority dopant.

1 13. The method set forth in claim 12 further including  
2 the additional step of forming an epitaxial layer  
3 on said selective P type buried layer after the  
4 step of implanting said second majority dopant.

1 14. The method set forth in claim 13 wherein the step  
2 of forming said epitaxial layer is performed  
3 before the step of diffusing said second majority  
4 dopant.

1 15. The method set forth in claim 14 wherein the step  
2 of diffusing said first majority dopant includes  
3 the step of controlling said diffusion such that  
4 said second majority dopant up diffuses into said  
5 epitaxial layer.

1 16. The method set forth in claim 12 further including  
2 the steps of:  
3 a) forming an N type layer on said non  
4 selective N type buried layer; and  
5 b) forming a P well extending from said  
6 selective P type buried layer through said N  
7 type layer.

1 17. The method set forth in claim 16 wherein the step  
2 of forming said N type layer is performed before  
3 the step of diffusing said second majority dopant.

1           18. The method set forth in claim 17 wherein the step  
2           of forming said P well includes the step of  
3           controlling the amount of a majority dopant used  
4           in forming said P well relative to the amount of  
5           said first majority dopant such that the maximum  
6           majority dopant concentration of said non  
7           selective N type buried layer is greater than the  
8           maximum majority dopant concentration of said P  
9           well.

1           19. The method set forth in claim 1 wherein  
2           a)       the step of forming said non selective N  
3           type buried layer includes the steps of  
4           implanting and diffusing said first majority  
5           dopant; and  
6           b)       the step of forming said selective P type  
7           buried layer includes the steps of  
8           implanting and diffusing said second  
9           majority dopant.

1           20. The method set forth in claim 19 wherein the steps  
2           of implanting and diffusing said first majority  
3           dopant are performed before the steps of  
4           implanting and diffusing said second majority  
5           dopant.

1           21. The method set forth in claim 19 further including  
2           the additional step of forming an epitaxial layer  
3           on said selective P type buried layer after the  
4           step of implanting said second majority dopant.

- 1           22. The method set forth in claim 21 wherein the step  
2           of forming said epitaxial layer is performed  
3           before the step of diffusing said second majority  
4           dopant.
- 1           23. The method set forth in claim 22 wherein the step  
2           of diffusing said first majority dopant includes  
3           the step of controlling said diffusion such that  
4           said first majority dopant up diffuses into said  
5           epitaxial layer.
- 1           24. The method set forth in claim 21 wherein the step  
2           of forming said epitaxial layer is performed  
3           before the step of diffusing said first majority  
4           dopant.
- 1           25. The method set forth in claim 24 wherein the step  
2           of diffusing said first majority dopant includes  
3           the step of controlling said diffusion such that  
4           said first majority dopant up diffuses into said  
5           epitaxial layer.
- 1           26. A method of fabricating a semiconductor device in  
2           a wafer comprising the steps of:  
3           a)        implanting across all of said wafer an N  
4           type dopant having a first coefficient of  
5           diffusion and at a first dose level;  
6           b)        diffusing said N type dopant into said wafer  
7           to form an N type buried layer;  
8           c)        masking a portion of said wafer;

9           d)       implanting into said wafer in areas not  
10               masked a P type dopant having a coefficient  
11               of diffusion greater than said first  
12               coefficient of diffusion; and  
13           e)       diffusing said p type dopants into said  
14               wafer to form a P type buried layer.

1       27. The method set forth in claim 26 wherein the step  
2       of implanting said N type dopant is performed  
3       before the step of implanting said P type dopant.

1       28. The method set forth in claim 26 wherein the step  
2       of implanting said P type dopant is performed  
3       before the step of implanting said N type dopant.

1       29. The method set forth in claim 26 wherein the step  
2       of implanting said P type dopant includes the step  
3       of controlling the amount of said P type dopant  
4       relative to the amount of said N type dopant such  
5       that said P type buried layer has a maximum dopant  
6       concentration greater than the maximum dopant  
7       concentration of said N type buried layer.

1       30. The method set forth in claim 26 further including  
2       the steps of:  
3       a)       forming an N type layer on said N type  
4               buried layer; and  
5       b)       forming a P well extending from said P type  
6               buried layer through said N type layer.

- 1 31. The method set forth in claim 30 wherein the step  
2 of forming said N type layer is performed before  
3 the step of diffusing said P type dopant.
- 1 32. The method set forth in claim 31 wherein the step  
2 of forming said P well includes the step of  
3 controlling the amount of a majority dopant used  
4 in forming said P well relative to the amount of  
5 said N type dopant such that the maximum majority  
6 dopant concentration of said N type buried layer  
7 is greater than the maximum majority dopant  
8 concentration of said P well.
- 1 33. The method set forth in claim 26 wherein the steps  
2 of implanting and diffusing said N type dopant are  
3 performed before the steps of implanting and  
4 diffusing said P type dopant.
- 1 34. The method set forth in claim 26 further including  
2 the additional step of forming an epitaxial layer  
3 on said P type buried layer after the step of  
4 implanting said P type dopant.
- 1 35. The method set forth in claim 34 wherein the step  
2 of forming said epitaxial layer is performed  
3 before the step of diffusing said P type dopant.
- 1 36. The method set forth in claim 35 wherein the step  
2 of diffusing said N type dopant includes the step  
3 of controlling said diffusion such that said N  
4 type dopant up diffuses into said epitaxial layer.

1 37. The method set forth in claim 34 wherein the step  
2 of forming said epitaxial layer is performed  
3 before the step of diffusing said N type dopant.

1 38. The method set forth in claim 37 wherein the step  
2 of diffusing said N type dopant includes the step  
3 of controlling said diffusion such that said N  
4 type dopant up diffuses into said epitaxial layer.

1 39. The method set forth in claim 26 wherein the step  
2 of implanting said N type dopant includes the step  
3 of selecting said N type dopant from one of  
4 arsenic or antimony and the step of implanting  
5 said P type dopant includes the step of selecting  
6 boron for said P type dopant.

1 40. A method of fabricating a semiconductor device in  
2 a wafer comprising the steps of:

3 a) growing an epitaxial layer doped with an n  
4 type dopant having a first coefficient of  
5 diffusion and a first doping level to form  
6 an N type buried layer;

7 b) masking a portion of said wafer;

8 c) implanting into said wafer in areas not  
9 masked a P type dopant having a coefficient  
10 of diffusion greater than said first  
11 coefficient of diffusion; and

12 d) diffusing said p type dopants into said  
13 wafer to form a P type buried layer.

1           41. The method set forth in claim 40 wherein the step  
2           of implanting said P type dopant includes the step  
3           of controlling the amount of said P type dopant  
4           relative to the amount of said first doping level  
5           such that said P type buried layer over  
6           compensates said N type buried layer completely  
7           throughout said N type buried layer in a region  
8           where said P type buried layer is formed.

1           42. The method set forth in claim 40 wherein the step  
2           of implanting said P type dopant includes the step  
3           of controlling the amount of said P type dopant  
4           relative to the amount of said first doping level  
5           such that said P type buried layer has a maximum  
6           dopant concentration greater than the maximum  
7           dopant concentration of said N type buried layer.

1           43. The method set forth in claim 40 further including  
2           the steps of:  
3           a)       forming an N type layer on said N type  
4                   buried layer; and  
5           b)       forming a P well extending from said P type  
6                   buried layer through said N type layer.

1           44. The method set forth in claim 43 wherein the step  
2           of forming said P well includes the step of  
3           controlling the amount of a majority dopant used  
4           in forming said P well relative to the amount of  
5           said first doping level such that the maximum  
6           majority dopant concentration of said N type

buried layer is greater than the maximum majority dopant concentration of said P well.

45. The method set forth in claim 40 further including the step of forming a second epitaxial layer on said N type buried layer.

46. The method set forth in claim 45 wherein the step of forming said second epitaxial layer is performed before the step of diffusing said P type dopants.

47. The method set forth in claim 40 wherein the step of growing an epitaxial layer includes the step of selecting said N type dopant from one of arsenic or antimony and the step of implanting includes the step of selecting boron for said P type dopant.

48. A method of fabricating a semiconductor device in a wafer comprising the steps of:

- a) bonding a device wafer doped N type to a first doping level with a dopant having a first coefficient of diffusion to a handle wafer by insulator bonding and separating a desired thickness of said device wafer to form an SOI layer which is also an N type buried layer;
- b) introducing P type dopants having a second coefficient of diffusion greater than said first coefficient of diffusion in a selected

13                    region of said SOI layer to form a P type  
14                    buried layer;  
15            c)        forming an epitaxial layer on the surface of  
16                    said SOI layer; and  
17            d)        diffusing so that the P type dopants extend  
18                    up into said epitaxial layer further than  
19                    the N type dopants in said SOI layer.

1            49. The method set forth in claim 48 wherein the step  
2                    of introducing said P type dopants includes the  
3                    step of controlling the amount of said P type  
4                    dopants relative to the amount of said first  
5                    doping level such that said P type buried layer  
6                    over compensates said N type buried layer  
7                    completely throughout said N type buried layer in  
8                    a region where said P type buried layer is formed.

1            50. The method set forth in claim 48 wherein the step  
2                    of introducing said P type dopants includes the  
3                    step of controlling the amount of said P type  
4                    dopants relative to the amount of said first  
5                    doping level such that said P type buried layer  
6                    has a maximum dopant concentration greater than  
7                    the maximum dopant concentration of said N type  
8                    buried layer.

1            51. The method set forth in claim 48 further including  
2                    the steps of forming a P well extending from said  
3                    P type buried layer through said epitaxial layer.

1        52. The method set forth in claim 51 wherein the step  
2        of forming said P well includes the step of  
3        controlling the amount of a majority dopant used  
4        in forming said P well relative to the amount of  
5        said first doping level such that the maximum  
6        majority dopant concentration of said N type  
7        buried layer is greater than the maximum majority  
8        dopant concentration of said P well.

1        53. The method set forth in claim 48 wherein the step  
2        of bonding includes the step of selecting the N  
3        type dopant from one of arsenic or antimony and  
4        the step of introducing P type dopants includes  
5        the step of selecting boron for said P type  
6        dopants.

1        54. A method for forming an N+ buried layer comprising  
2        the steps of:  
3        a)        oxidizing the top and bottom surfaces of an  
4               N+ device wafer;  
5        b)        bonding a handle wafer to said bottom oxide  
6               layer; and  
7        c)        removing said top oxide layer.

1        55. The method set forth in claim 54 further including  
2        the step of thinning said N+ device wafer.

1        56. A method for forming an N+ buried layer comprising  
2        the steps of:

- 3           a)     providing a device wafer bonded to an oxide
- 4                   layer which, in turn, is bonded to a handle
- 5                   wafer;
- 6           b)     implanting N type dopants into said device
- 7                   wafer across the entire top surface of said
- 8                   device wafer; and
- 9           c)     diffusing said N type dopants into said
- 10                  device wafer.